

slipping and loss of effect will certainly occur. It is conceivable that there is a middle zone between these two extremes that is effective, but it is unlikely that any surgeon will tie his sutures with just the degree of tension which will always prevent the occurrence of both unfortunate results.

In addition to the difficulty and possible ineffectiveness of scleral suturing, the hazards of perforating the sclera with the needle, particularly in the hands of a beginner, should not be overlooked. The sclera at the site where the long muscle must be reattached in the Worth operation is seven-tenths millimeter thick. Considerable skill is required to lay these sutures accurately and effectively. The hazard of penetration in the recession operation is even greater because the sclera beneath the insertion of the internal rectus near the equator of the eyeball is but 0.5 millimeters thick, and the possible exposure for laying sutures in this region is small.

These measurements are taken from Whitnall's figures, which were compiled from adult sclerae, and they are naturally, of course, somewhat smaller in young patients.

TUCKING OPERATIONS

In an attempt to overcome this very obvious difficulty, tucking operations were invented in the interests of safety, so that if the operation were unsuccessful the patient would, at least, be no worse than before operation. Tendon tucking operations are also open to the same objections mentioned above, viz., sloughing and slipping.

O'CONNOR OPERATION

The O'Connor procedure which obviates both difficulties is illustrated by Figures 1 and 2.

This technique will permit operation as early as two and a half years, and the prospects of securing binocular vision are thereby very greatly enhanced.

DEVELOPMENT OF BINOCULAR VISION

Most oculists agree that only in exceptional cases does binocular vision develop after the age of seven if it has not been present before this age. There is little prospect that binocular vision will develop spontaneously unless the eyes are reasonably close to the normal alignment so that, from every point of view, early operation is advisable.

EYE EXERCISES

In the past few years there has been a tremendous growth of interest in so-called eye exercises, or orthoptic training. Doctor Hicks and myself have been able to verify the observations which were made repeatedly by pioneer ophthalmologists that, until the visual acuity of the two eyes is approximately equal, although not necessarily normal (ratio of 20/20 in the better eye to 20/40 or 20/50 in the poorer eye) very little can be accomplished toward the stimulation of binocular vision by orthoptic training. Marlow has shown that the anatomical position of rest of the eyes cannot be permanently altered by exercise. Prolonged orthoptic training in a person with good binocular vision may improve the muscle

balance temporarily. Nevertheless, a prolonged occlusion test will show that the eyes quickly revert to their original position of rest. These principles limit the applicability of this method of treatment to a small percentage of strabismus cases. Many oculists and optometrists who are enthusiastically exercising the eyes of their patients for a few minutes a day, seem to be totally unaware of these principles.

SUMMARY

1. The etiology of convergent concomitant strabismus is discussed.
2. The principles of treatment are enumerated.
3. The most important advance in the surgical technique of correcting cases which require operation is described.
4. Binocular vision is briefly discussed.
5. The principles which govern the success or failure of so-called eye exercises are recalled.

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THE LURE OF MEDICAL HISTORY*

MR. JOHN HUNTER ON GENERATION †‡

By ARTHUR WILLIAM MEYER, M. D.
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I

FURTHER words about John Hunter, unless based on new sources, would seem to need justification. For me this lies in the surprising fact that the illustrations accompanying his notes on the development of the "chick of the goose" apparently have never been published, except that Owen included part of the series, in retouched form, in the "Physiological Catalogue," which is difficult of access. Moreover, Hunter's embryological studies still continue to be overlooked or are dismissed with a mere mention. In his new "History of Embryology" as well as in the large work on "Chemical Embryology," Needham gave John Hunter but scant attention and he was given still less in a recent volume on the history of embryology—"Die Embryologie im Zeitalter des Barock und des Rokoko"—by Bilikiewicz (1932). In this work John Hunter was mentioned only in a footnote, while the name of his brother William led the heading of a subdivision. The footnote concerned merely stated that John, the younger brother of William, helped him in the production of the work on the gravid uterus.

THE PLACE OF WILLIAM HUNTER IN THE HISTORY OF EMBRYOLOGY

It certainly does not seem just that William should be given a place in the history of embryology, and that John should be denied it. What-

*A Twenty-Five Years Ago column, made up of excerpts from the official journal of the California Medical Association of twenty-five years ago, is printed in each issue of CALIFORNIA AND WESTERN MEDICINE. The column is one of the regular features of the Miscellany Department, and its page number will be found on the front cover.

† Because John Hunter occupies so large a place in the development of surgery, it is commonly but erroneously assumed that he had the title of Doctor of Medicine.

‡ From the department of anatomy, Stanford University Medical School.

ever his share in the production of the rightly famous monograph upon which William's claim largely rests, John's efforts did not cease there. As Paget (1897) said, he ". . . studied the development of eggs, and pursued his studies for fifteen years; 'surely one might suppose that this was the great work of his life; yet it seems to have been rather a casual by-the-way pursuit.'" (p. 249.) I have not been able to learn how just it is to speak of John's observations on geese as casual, and whether those on bees which are said to have continued for twenty years also could rightly be called casual. However, it would seem that anyone whose interest in a subject was sufficiently enduring to last for almost four decades,* and who kept geese and bees for the sole purpose of study, probably gave the subject more than casual attention. The "Observations on Bees," it seems to me, well support this inference, which is also implied by the words of Sedgwick (1910), who wrote: "The great work of William Hunter on the human gravid uterus, containing unequalled pictorial illustrations of its subject from the pencil of Rymsdyk and other artists, was published in 1775; and during a large part of the same period numerous communications to the *Memoirs* of the Royal Society testified to the activity and genius of his brother, John Hunter, in the investigation of various parts of comparative embryology." (p. 325.)

THE LURE OF THE PROBLEM OF REPRODUCTION TO JOHN HUNTER

One could assume that such an inquiring, restless and fertile mind as John Hunter's could not fail to be attracted by the problem of reproduction. The *Essays and Observations on Natural History, Anatomy, Physiology, Psychology, and Geology*, contain fifteen pages under the heading, "Observations on Generation"; seventeen on "Progress and Peculiarities of the Chick"; sixty on the "Generation of Fish and Shellfish"; four on the "Generation of Insects"; eleven of "Notes and Queries on Generation" and twelve "On Monsters," making 119 pages in all. In addition, there are 116 pages in his "Observations on Certain Parts of the Animal Economy," reprinted from the *Philosophical Transactions of the Royal Society*, which may rightly be included among his writings on the broad topic of generation. It is true that some of the items contain much that we now include under anatomy and comparative anatomy, and other matters that belong under the heading of the physiology of reproduction; but it would be just as unfair to exclude these from consideration as in the case of Harvey or any of the other older writers. They all used the term "generation" to include what we now consider under the topic of reproduction and teratology, that is, the anatomy and physiology of sex, embryology and the formation of monsters.

* Hunter says that ". . . about the year 1755 or 1756," he ". . . was making drawings of the growth of the chick in the process of incubation" (*Treatise on the Blood*, page 107), mentioning in this connection experiments on the eggs of the duck and the hen; and one of the drawings illustrating his "Progress and Peculiarities of the Chick" bears the inscription, "St. Aubin Delineavit. 1793."

JOHN HUNTER'S IDEAS AND OBSERVATIONS ON GENERATION

It is not my purpose to analyze or summarize all of Hunter's notes upon this subject, but merely to give adequate attention to some of his ideas and observations on generation. These concerned a number of species, and included observations and experiments upon cross-fertilization, castration and artificial insemination. Since he had the interests of a comparative anatomist, he made observations upon many different animals, although they often were not minute. Even in his twenty-year-long study of the bee, Hunter wrote: "The history of the bee has rather been considered as a fit subject for the curious at large, whence more has been conceived than observed. Swammerdam, indeed, has rather erred on the other side, having with great industry been very minute on the particular structure of the bee. I shall here observe that it is commonly not only unnecessary to be minute in our description of parts in natural history, but in general improper. It is unnecessary when it does not apply to anything but the thing itself, more especially if it be of no consequence; but whenever it applies, then it should so far be treated accurately. Minutiae, beyond what is essential, tire the mind, and render that which should entertain along with instruction heavy and disagreeable; the more so, too, if the parts are small, where the sense can only take them in singly, and the mind can hardly comprehend the whole or apply all the parts combined to any consequent action. This has been too much the case with Swammerdam; he often attempted too much accuracy in his description of minute things." (*Animal Economy*, p. 416.) In commenting upon these words, Owen rightly said: "If the objects of the comparative anatomist were limited to the elucidation of the function of the organs he dissected, there might then, perhaps, be some reason in the animadversions in the text; but his researches have a still higher aim, viz., to trace the general plan which pervades the construction of animals amidst the various modifications to which each organ is subject in reference to particular functions; and the study of organic homologies requires that attention be paid to the minutest particulars, independently of considerations as to the uses in the economy to which they may be subservient." (*Ibid.*)

HUNTER'S NOTES "ON THE PROGRESS AND PECULIARITIES OF THE CHICK"

It is not generally known that Hunter's notes "On the Progress and Peculiarities of the Chick," partly in his own hand, are among the few things that escaped the ruthless act of Home, and that they fortunately are still in the Archives of the Royal College of Surgeons of England. Moreover, it frequently is overlooked that these observations were not on the chick, but on the common goose. While undertaking these studies, Hunter said: ". . . I found the first appearances so obscure, from want of size in the object, that I had recourse to the progress of the chick in the egg of the goose. I attempted the swan, but it

was impossible to procure such numbers as to give me all the necessary varieties. I endeavoured to procure ostrich's eggs, by having them sent to me in spirits; but as the getting such was only a matter of chance, and only one or two in thirty years! nothing could be made out from them. For this purpose, then, I kept a flock of geese for more than fifteen years, and by depriving them of their first brood in my investigations, they commonly bred again the same season." (Essays and Observations, i, pp. 205-206.) Hunter regarded the bird egg as so favorable an object for embryological study that he said "... It would almost appear that this mode of propagation was intended for investigation."

HUNTER'S DRAWINGS OF THE DEVELOPMENT OF THE CHICK

I was greatly surprised to find some years ago that "the Hunterian drawings of the development of the chick," which Sir Richard Owen said were preserved in the Royal College of Surgeons, had never been reproduced, except in part by Owen and a few by the editor of the Treatise on the Blood. Moreover, inquiry of several of the foremost historians of medical science brought no information regarding the matter. A request to have them photostated brought the comment from a London firm, that they also believed that the illustrations "have never been reproduced." Although some of the notes on the "chick of the goose" seem to be in Hunter's own handwriting, the illustrations apparently were made not by, but for him, notwithstanding they undoubtedly had his approval.

According to a letter from Stevens and Brown, who reproduced them for us, the following items on this subject are contained in the Library of the Royal College of Surgeons:

"1. The original ms. of *'Progress and Peculiarities of the Chick,'* partly in Hunter's handwriting. (Printed in *'Essays and Observations'* 1861 and in the concluding volume of *'Physiological Catalogue'* 1840). No illustrations in the ms.

"2. *'Description of Rymsdyke's drawings of the incubation of the Egg.'* Ms., partly in Hunter's handwriting. Immediately preceding this ms. are five pages of illustrations in ink and six outlines of the large crayon drawings (about which the description is written), also in ink.

"3. Five folios of a large volume on which are pasted pencil drawings, made for Hunter, but not drawn by him, and which illustrate his *'Progress and Peculiarities of the Chick.'*"

Although Hunter's manuscript on "The Progress and Peculiarities of the Chick" contains many general reflections and deductions, it is accompanied by a total of 130 splendid drawings by Bell and St. Aubin and seems to have been based mainly on the chick of the goose. However, Hunter also studied the development of the chick of the hen. This is indicated by two sets of drawings accompanied by legends. The first of these sets is marked "Description of Rymsdyke's drawings of the incubation of the egg. In crayons framed and glazed," and a boxed caption on the second page contains the words: "The Outlines of the Drawings in the Frame of the Progress

of the Chick." These comprise seven plates, containing twenty-five illustrations on the development of the chick, which are pen drawings by Rymsdyke, all accompanied by legends revised by Hunter and partly in his own hand. These drawings are sketches rather than finished illustrations and some of them are mere outlines, but none of them are accompanied by guide lines nor do they bear the letters used in the legends. They illustrate the unincubated hen egg and 15, 40, 46, 58, 69, and 93 hour and later stages in incubation. All of the illustrations apparently are re-numbered in Hunter's own hand. The second "frame" of the drawings concerns oögenesis and is similarly captioned in a box with the words, "The Outlines of the Drawings in the Frame of the Progress of the Egg." This set contains six plates with twelve drawings of the same type.

In addition to these and the illustrations on the development of the goose, there are eight drawn by William Bell, on the development of the feathers in blackbirds before hatching, and there apparently are several more on the development of "... the down in the gosling, before exclusion, three weeks after incubation had commenced." The former comprise Plates XLV and XLVI in Volume III, Part 2, of the *Physiological Catalogue* published in London in 1836, and the latter are referred to by Owen in the same volume as "No. 123, Manuscript Catalogue of Drawings."

HUNTER'S DIRECTIONS ON METHODS OF PROCEDURE

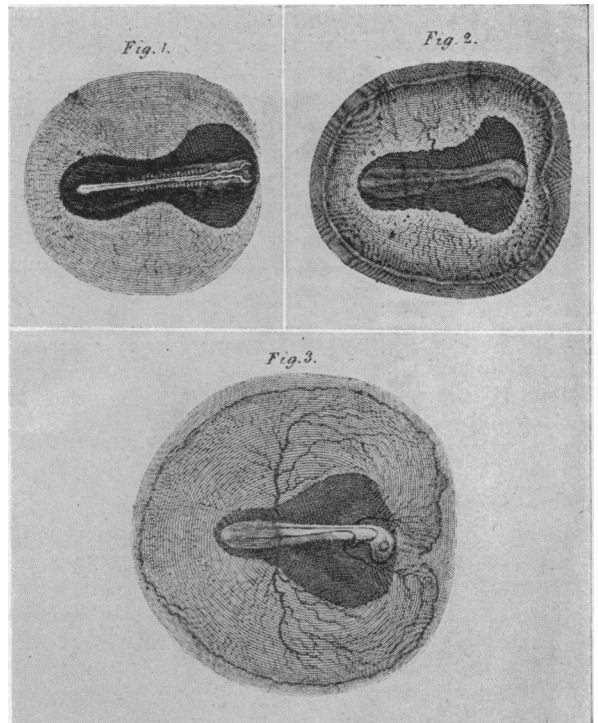
One of the most interesting paragraphs in connection with Hunter's notes on the development of the goose is that on "... the different Methods to be taken to examine the Progress of the Chick in incubated Eggs." Every beginner in chick embryology might well read these directions and try his own hand at following them. He would get a much better comprehension of the difficulties that the early investigators encountered, and a better appreciation of their resourcefulness. He could not help being impressed with Hunter's experimental attitude and could personally test two of the statements which he makes in connection with his comments on technique.

Hunter gave directions for removing the shell and the shell membrane, in order to observe the progress of incubation, and tried to incubate eggs in warm water in order to observe the process of development better; but he found that the embryos always died after a few hours. In a footnote in connection with this statement, he wrote that he used water of 204 degrees; but from his own statement elsewhere, it seems that this may be a misprint, for he must have known that this temperature was too high. He used every care, and even emphasized that one must observe the development of the chick during the night as well as during the day; but the use of a microscope is mentioned little and that is not without significance. Although Hunter acknowledged that magnifying glasses "... appear to give a good deal of information" regarding the blood, he was skeptical of them, and regrettably surmised that

Malpighi and Leeuwenhoek "... probably imagined more than they saw." He also wrote a long footnote containing almost eight hundred words on the difficulties encountered in the use of the microscope. Hence it is not surprising that, under the title "Red Globules," he declared: "Whatever their shape is, I should suppose it to be always the same in the same animals, and indeed in all animals, as it must depend upon a fixed principle in the globule itself." (Treatise on the Blood, p. 65.) That it did not occur to a zealous comparative anatomist such as Hunter to place drops of blood from different animals under the microscope in order to ascertain the shape of the erythrocytes, can only be accounted for, it seems to me, by his distrust of the instrument. He further thought that the red globules are "the less important" constituent of the blood. This seems very strange indeed, when it is recalled that he rightly looked upon the allantois as the lung of the unhatched chick, and even described the difference in color of the blood in the allantoic veins and arteries; and that he knew that the color of the blood was due to the color of the red globules, and was not due to the "serum and lymph" as he said.

Regarding the formation of the red globules, he wrote: "They appear not to be a natural part of the blood, but, as it were, composed out of it, or composed in it, and not with it; for they seem to be formed later in life than either of the other two [that is, serum and lymph*]; thus we see, while the chick is in the egg, and the heart beating, it then contains a transparent fluid before any red globules are formed, which we may suppose to be the serum, and the lymph. The globules do not appear to be formed in those parts of the blood already produced, but rather to rise up in the surrounding parts." In a footnote to this statement, Hunter added: "Thus, on some of the first appearance of the chick we find a zone surrounding it, composed of dots, which contain red globules, but not in vessels, and which zone becomes vascular afterwards. Vide Plate I." (*Ibid.*, p. 71.) (See Figures 1, 2, and 3.) He wrote further, "... I have therefore suspected that parts have the power of making vessels and red blood independent of circulation. This appears to be evidently the case with the chick in the egg." (*Ibid.*, p. 335.) As far as I am aware, this observation and conclusion of Hunter's, on the formation of the blood islands, was a noteworthy contribution to the subject. In connection with this idea, the editor of the *Treatise on the Blood* spoke of the position laid down in the work, "that when new vessels are produced in a part, they are not always elongations from the original ones, but vessels newly formed, which afterwards open a communication with the original." (Explanation of Plate I.)

When writing "Of the Living Principle of the Blood," Hunter declared: "To conceive that blood



Figures 1, 2 and 3 constitute Plate I in Hunter's *Treatise on the Blood*. In the atlas edited by Palmer, it is stated:

"In this plate is represented the embryo of the chick in the incubated egg, at three different stages of its formation, beginning with the earliest visible appearance of distinct organization. The preparations from which these figures are taken form part of a complete series, contained in Mr. Hunter's collection of comparative anatomy. They are meant to illustrate two positions laid down in this work, viz: That the blood is formed before the vessels, and when coagulated, the vessels appear to arise; that when new vessels are produced in a part, they are not always elongations from the original ones, but vessels newly formed, which afterwards open a communication with the original.

"Fig. 1. In this figure the only parts that are distinctly formed are two blood-vessels; on each side of these is a row of small dots or specks of coagulated blood, which are afterwards to become blood-vessels.

"Fig. 2. The formation of the embryo is further advanced, vessels appear to be rising up spontaneously in different parts of the membrane; and the specks, out of which they are produced, are in many parts very evident.

"Fig. 3. The number of blood-vessels is very considerably increased; they now form a regular system of vessels, composed of larger trunks, and a vast number of ramifications going off from them. . . ." (p. 9.)

According to Owen, "These figures were selected by Mr. Hunter for their present purpose, from an extensive series of drawings of the embryo of the goose at different stages of development, and of which he left only a general account in manuscript, but no detailed descriptions. The above explanations of the figures were doubtless added by the Editor of the original Edition of the '*Treatise on the Blood*'; that they are not from the pen of Mr. Hunter is evident from the fact of there being upwards of ten figures in the original series, showing as many stages of the development of the embryo, *earlier* than that represented in Fig. 1, but with a visible and distinct organization. After a comparison of these figures with the embryo of the fowl and emeu at corresponding stages of development, I would propose the following explanation of them. At the period represented in Fig. 1, red blood is not formed, but although the heart is beating, it then contains a transparent fluid before any red globules are formed," as Mr. Hunter has justly observed (vol. iii, p. 66 of the present Edition). The colourless fluid which circulates at this period, when the chick may be compared with the white-blooded invertebrate animals, is not, however, composed entirely, as Mr. Hunter supposed, of the serum and lymph, but contains many colourless globules, smaller than the red blood-discs of the mature bird, and presenting, under a very high magnifying power, a granular structure like the colourless nuclei of the blood-discs. While, however, the embryo thus exhibits an analogy to the white-blooded animals in the nature of its circulating fluid, it expresses at this, and even at an earlier period, the essential characters of the great division of animals to which it belongs. The row of dots, on each side of the two longitudinal white lines, are the primitive cartilages in which the ossification of the vertebrae commences; and the lines themselves are the folds of the serous layer of the germinal membrane, including the rudiments of the spinal chord and brain; the

* In this and subsequent quotations from Hunter's writings, italics in brackets indicate words inserted by the author, brackets those introduced by Sir Richard Owen, while footnotes by John Hunter quoted here are so marked.

is endowed with life, while circulating, is perhaps carrying the imagination as far as it well can go; but the difficulty arises merely from its being fluid. . . . Our ideas of life have been so much connected with organic bodies, and principally those endowed with visible action, that it requires a new bend to the mind to make it conceive that these circumstances are not inseparable. It is within these fifty years only that the callus of bones has been allowed to be alive. . . ." (pp. 106-107.) . . . "Dr. Hunter was the first who showed callus to be endowed with the principle of life, as much as bone." John stated that he " . . . was led to this notion about the year 1755 or 1756, when . . . making drawings of the growth of the chick in the process of incubation," and it should be remembered that he undertook a large series of experiments in order to test this idea, without observing anything that controverted it.

EQUIVOCAL GENERATION

Hunter thought that evolution, epigenesis and metamorphosis all shared in the various forms of development, and it is related that when one of his pupils asked him if his ideas regarding life "did not make for the exploded doctrine of equivocal generation," he allowed that " . . . perhaps it did, and that as to equivocal generation, all we could have was negative proofs of its not taking place. He did not deny that equivocal generation happened. There was neither positive proofs for nor against it taking place." He thought that at the very beginning there are parts which continue throughout life and added: " . . . such is, probably, the *Materia Vitae universalis* and the Absorbing System, which may indeed, according to the third principle, be changed." (Essays and Observations, p. 204.)

HUNTER'S VIEW CONCERNING THE LYMPHATIC SYSTEM

That he should have thought that the lymphatic, or absorbing system, was present in the unincu-

three divisions of which, viz., medulla oblongata, optic lobes, and cerebral hemispheres, are indicated by the dilatations which succeed each other from behind forwards, towards the anterior or upper end of the embryo. The semicircular white line, surrounding the rudimental head, is the fold of the serous layer of the germinal membrane, forming the circumference of the depression in the yolk, into which the head is beginning to sink. This fold afterwards extends downwards over the dorsal aspect of the embryo, and forms the amnios. The concave edge of the fold thus descending is slightly indicated near the lower dilated part of the embryo at Fig. 3. The projection on the right side of the embryo (which is seen from behind) opposite the second cerebral enlargement, is the *punctum saliens*. There is little doubt that Mr. Hunter intended this figure to represent the stage at which colourless blood is circulated, as described in the passage above quoted. And it may be observed that this most interesting fact in the history of the development of the vertebrate embryo has been lately reproduced (by MM. Coste and Delpech), and generally received as a recent discovery.

"The 2nd figure illustrates the observation, 'the globules do not appear to be formed in those parts of the blood already produced, but rather to rise up in the surrounding parts.' The outline of the *punctum saliens*, or rudimental heart, is rendered conspicuous by the red blood which it now circulates: the red globules are aggregated in different parts of the *opake area*. In the third figure the zonular, or terminal sinus is formed, and the circulation of red blood is established in the omphalo-mesenteric vessels, distributed over the yet incomplete vitelline sac. It is obvious from Mr. Hunter's own description that vessels, and the heart itself, pre-exist in the embryo to the formation of red globules; and I have myself observed, in the surrounding *opake area*, at the period corresponding to that represented in Fig. 1, canals already established before the red coloring matter had made its appearance.—R. Owen." (pp. 9-10.)

bated egg seems very strange to us who know how it develops, but it is important to remember that, from his own and William's ingenious experiments on veins as absorbents, John had concluded " . . . that the red veins do not absorb in the human body. The fair inquirer after truth will be convinced, by the observations which occurred to me, that the common opinion—that they do absorb—is supported by some proofs that are at least doubtful or equivocal, and that the other opinion is not without plausibility; and he must allow that my brother's experiments render it highly probable." (Animal Economy, p. 311.) This shows that John was overimpressed with the rôle of the lymphatics, and concluded that they were present from the beginning. According to Abernethy, mentioned by Butler (1910), Hunter, when asked " . . . how he could suppose it possible for absorbents to do such things as he attributed to them, replied: 'Nay, I know not, unless they possess powers similar to those which a caterpillar exerts when feeding on a leaf.'" (p. 941). He further wrote: "As we know nothing of the mouths of these vessels, it is impossible we can form any opinion that can be relied on; but as they are capable of absorbing substances in a state of solidity and fluidity, it is reasonable to suppose that they have different modes of action; for although any construction of parts that is capable of absorbing a solid may also be such as is capable of absorbing a fluid, yet I can suppose a construction capable of absorbing a fluid that is not fitted for the absorption of a solid, though this is not likely." (Principles of Surgery, p. 51.)

It often has been said, and very recently so, that Hunter's discovery of the lymphatic system ranks next to Harvey's of the circulation, but that is a serious error. Hunter seems to have recognized lymphatics in birds, and from his ingenious experimental work correctly conceived of the lymphatics as a general absorbing system; but he overshot the mark by insisting that absorption did not occur also through the venous system.

THE "CASE OF SUPERFÆTATION IN A NEGRO WOMAN"

Perhaps the most notable instance of misconception regarding generation, because so often quoted, is the "Case of Superfætation in a Negro Woman." I have seen it referred to repeatedly in medical literature, and also by those who wrote on the life and work of John Hunter; yet, as Owen points out, Hunter probably received this story "at third hand, from N. L.," and I feel prompted to add that the mere fact that a woman gives birth to two children from different fathers in no way implies the occurrence of superfætation. Moreover, the story itself suggests that there was no ground whatever for regarding it as such, any more than there would be for regarding an instance of a litter of cats or dogs containing individuals of different paternity as indicating the occurrence of superfætation.

THE THEORY OF RECAPITULATION

John Hunter apparently had a fair conception of the theory of recapitulation, the formulation of which is usually attributed to Fritz Müller about a century later. Hunter declared: "If we were capable of following the progress of increase of the number of the parts of the most perfect animal, as they first formed in succession, from the very first, to its state of full perfection, we should probably be able to compare it with some one of the incomplete animals themselves, of every order of animals in the Creation, being at no stage different than some of the inferior orders. Or, in other words, if we were to take a series of animals, from the more imperfect to the perfect, we should probably find an imperfect animal, corresponding with some stage of the most perfect." (*Ibid.*, p. 203.) In a footnote on this quotation, Richard Owen, who also emphasized the importance of this generalization, added: "The same philosophical idea seems to have governed Hunter in penning the following passage: 'We may also observe that the first rudiments of every animal are extremely soft, and even the rudiments of the more perfect are similar to the full-grown imperfect, and as they advance in growth they become firmer and firmer in texture.'—Croonian Lecture by Hunter for the year 1782, *Animal Economy*, p. 268."*

(To be continued)

CLINICAL NOTES AND CASE REPORTS

BLEEDING FROM THE ANUS—ITS SIGNIFICANCE

By A. H. WEITKAMP, M.D.
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THE passage of blood from the anus is a fairly common occurrence and, next to pain, most frequently sends the patient to his physician. Quite a number of causes are found for this condition. As to the location from which this bleeding arises, distinguishing characteristics may be recognized: first, in bright blood by itself; second, blood mixed with mucus, pus, or feces; and third, very dark blood, or even tarry stools.

1. Bright blood, which comes by itself or, at most, streaking the outside of stools, always is from the anus or terminal end of the gastro-intestinal tract. Of the pathological processes responsible for this, fissure or ulcer in ano are the nearest to the anal orifice, and their presence may be suspected by the sudden onset of an exquisite pain followed by a small amount of blood coming with or after defecation.

Next we note those cases, usually in adults, in which bleeding comes on painlessly, or practically so, either with or without defecation. Hemor-

rhoids will be the most common cause, although proctitis, neoplasms, and trauma are also to be considered. In the case of trauma any foreign body, such as bones, wire, pins, tacks, or almost any object the person may swallow or introduce through the anus, may be the cause. It must not be forgotten, however, that faulty instrumentation, either with the enema tube or the physician's instruments, may be the traumatizing agents.

If this fresh blood occurs in childhood, the cause will, in all probability, be either polypi, prolapsus, intussusception, or trauma from some object which has been swallowed.

2. Blood mixed with stool, pus, or mucus must, of necessity, come from a somewhat higher source than the former in order to give time and opportunity for the commingling of these elements. The majority of the pathological processes producing this condition are most serious, life-sapping, and distressing diseases.

The most common cause here is one or the other of the various dysenteries. Of these the acute bacillary is the most sudden in onset and has a rather profuse flow of blood. Occasionally, especially in the tropics, amebic dysentery may closely simulate the preceding, although usually it is more chronic and slower of onset. Chronic ulcerative colitis and balantidial dysentery have a rather insidious start, are slower to show bleeding, but very chronic in their course. Fortunately, typhoid, which in the past has been such a devastating disease, is now only rarely seen, but must be remembered as a possible cause in bleeding commingled with stools.

The microscopic examination of feces, as also the inspection by way of the proctoscope, go a long way in indicating the causative agent of these dysenteries.

Two exceedingly grave obstructive lesions must be remembered as productive of bleeding, namely, malignancy and stricture. In the case of cancer in the distal portion of the gastro-intestinal tract, the growth tends to encircle the lumen of the gut, with a consequent stasis of the bowel contents and the setting up of an irritative process. The neoplasm at the same time undergoes ulceration and infection, with a resultant destruction of the mucin-bearing cells and the underlying tissue. Hence, we have a foul-smelling discharge which, if it comes from the cancer alone, consists of pus, serum, and blood; but if the obstruction is not complete, will also have a more or less watery stool and mucus mixed therewith.

Should the obstructive lesion be a benign stricture, the sufferer will usually be a woman. The cause in almost every case will be that dread fourth venereal disease, regarding which we still know very little, lymphogranuloma inguinale. The discharge differs from that of cancer in that there is usually a greater amount of pus and mucus with a small amount of blood, often dribbling away to such an extent as to necessitate the wearing of a pad.

As further possible causative agents for stools with recent blood, one will remember polyposus, trauma, and some cases of diverticulosis.

* A fuller discussion of the historical aspects of the law of recapitulation can be found in my article on the subject in a forthcoming number of the *Quarterly Review of Biology*.